Assessment Performance Measure Name and Number

SE-A1 Surface Water Discharges to Biscayne Bay

Justification and Current Condition

Freshwater flows into Biscayne Bay are strongly manipulated by human activities and will undergo extensive changes with the implementation of the CERP. Changes include the modification of volume and timing of water distribution, the replacement of certain canals and related structures with sheet flow-producing structures, and the restoration of more natural freshwater delivery regimes. Currently, 12 canals discharge fresh water directly into Biscayne Bay, seven of them directly and indirectly into Biscayne National Park waters. The alteration of surface water discharges is the primary mechanism for changing salinity patterns within Biscayne Bay.

For this performance measure, Biscayne Bay is considered to be bounded by Snake Creek (Oleta River State Park) to the north and the southern border of Biscayne National Park to the south. Most of the fresh water currently delivered to Biscayne Bay is through surface water discharges from the mouths of drainage canals located along the western shoreline of the bay.

Current flows to Biscayne Bay, as calculated by the SOUTH FLORIDA WATER MANAGEMENT MODEL under 1995 Base conditions, are as follows:

Area	Structure	Wet Season (acre-feet)	Dry Season (acre-feet)
Snake Creek		121,000	51,000
North Bay	G58+S28+S27	99,000	41,000
Miami River	S26+S25B+S25	132,000	60,000
Central Bay		161,000	64,000
South Bay		158,000	52,000
Barnes Sound	S197	6,000	0

These should be viewed as minimum monthly flows; excessive flow does not seem to be problem in general.

CERP Restoration Expectation

Increase inflows to southern Biscayne Bay via the tidal creeks and herbaceous marshes of the South Dade Wetlands. Maintain total annual volumes of surface water discharge to Biscayne Bay that equal or exceed those under base conditions:

Area	Wet Season (acre-feet)	Dry Season (acre-feet)
Snake Creek	66,500	93,000
North Bay	99,000	41,000
Miami River	132,000	60,000
Central Bay	161,000	83,000
South Bay	158,000	68,000

Monitoring Protocol

Measure freshwater discharges into Biscayne Bay at all structures and other inflows.

Source

Biscayne Bay CEM stressor
Southern Estuaries and South Florida Monitoring Network Monitoring and Assessment Plan modules 3.2.3.2 and 3.5.3.3, respectively (RECOVER, 2003a)

Contact

RECOVER AAT

Steve Davis, SFWMD
Gwen Burzucki, Miami-Dade County DERM

Assessment Performance Measure Name and Number

SE-A2 Southern Estuaries Salinity Pattern

Justification and Current Condition

The alteration of salinity patterns is one of the most profound changes anticipated to occur within the southern estuaries as the result of the modification of the volume, timing and distribution of freshwater inflow and the replacement of certain canals and related structures with sheet flow-producing structures. Salinity is a major variable affecting submerged aquatic vegetation and the value of estuaries as habitats nursery grounds for sport and commercial species of epibenthic fauna.

CERP Restoration Expectation

Florida Bay - Provide less abrupt and less extreme decreases in salinity in the northeastern bay. Reduce the frequency, extremity and extent of hypersaline conditions in the central, southern and western bay. Increase the frequency and extent of low salinity conditions in the central bay. Increase the frequency and extent of salinities less than that of seawater in the western bay, extending westward along the Gulf of Mexico coastal shelf to Lostman's River.

Biscayne Bay - Provide mesohaline salinity patterns in the nearshore environment of the bay. Lower salinity in the mouths of tidal creeks. Specific regions that are anticipated to be effected and the associated CERP projects are the Miami River/Rickenbacker-McArthur Causeway basin (proposed modification of water deliveries), the Little River/Dumbfoundling Bay/Oleta River basin (proposed modification of water deliveries), the Biscayne Coastal Wetland area of south Biscayne Bay (Biscayne Bay Coastal Wetland Project), and the Manatee Bay/Card Sound region (C-111 Spreader Canal Project). Specific targets will be developed by the supporting research project "Experimental Design for Evaluating Salinity Relationships of Epifaunal Species in Western Biscayne Bay" that will be designed and initiated in 2003-2005.

Mangrove Estuary - Lower salinity to oligohaline levels in coastal lakes and basins.

Monitoring Protocol

Florida Bay - The current National Park Service salinity monitoring network is deemed to be sufficient for Florida Bay with the addition of four telemetry stations to the fourteen already in place. The locations that need to be added include Snake Bight, West Lake, Seven Palm Lake and east of Cape Sable (between Flamingo and the SEAKEYS/COMPS station just south of Cape Sable).

Biscayne Bay - Biscayne Bay salinity monitoring will use 14 preexisting stations throughout the bay that were established by the USACE and Biscayne National Park and provide continuity with historical data. An additional 14 sites have been identified to provide appropriate documentation of the extent and stability of the CERP related effects throughout the bay. Some specific sites are proposed in areas where there will be no anticipated CERP effect to provide comparison or control locations to allow identification of more systemwide (rather than CERP specific) effects. The additional sites will include continuous recording salinity monitoring stations with both surface and bottom mounted meters in the critical regions of the bay, including shallow nearshore areas. Station locations have been selected and coincide with established, long-term water quality stations where possible.

Source

Florida Bay, Biscayne Bay, and Mangrove Estuary Transition Zone CEMs stressor
Southern Estuaries Monitoring and Assessment Plan module 3.2.3.2 (RECOVER, 2003a)

Contact
RECOVER AAT Steve Davis, SFWMD

Assessment Performance Measure Name and Number

SE-A3 Southern Estuaries Submerged Aquatic Vegetation Distribution, Abundance and Community Structure

Justification and Current Condition

One of the main biological targets of CERP for the restoration of Florida Bay and Biscayne Bay is improved seagrass habitat. Seagrasses are the dominant estuarine communities to be affected by the CERP, and they provide the majority of the fisheries habitat. Continuation of existing seagrass monitoring programs and expansion of sampling into areas likely to be affected by CERP projects will provide an effective approach to track the net effects of CERP-related changes in critical ecosystem parameters (e.g., salinity, water quality, phytoplankton, etc.) on seagrass habitats. Seagrass-habitat assessment will also provide valuable verification data for current and future modeling efforts. Current conditions include various stages of seagrass die-off and recovery in Florida Bay, limited coverage and duration of seasonally-occurring SAV beds in the coastal lakes and basins of the Everglades-Florida Bay ecotone, and absence of seagrass in extensive areas of nearshore habitat along the western shoreline of Biscayne Bay.

CERP Restoration Expectation

Florida Bay - Recover seagrass beds over most of bay bottom, extending west along the Gulf of Mexico coastal shelf to Lostman's River. Replace *Thalassia* monoculture with mixed *Thalassia* and *Halodule*.

Mangrove Estuary - Increase cover and seasonal duration of *Ruppia*, *Chara*, *Najas* and *Utricularia* in coastal lakes and basins.

Biscayne Bay – Increase cover of seagrass beds, consisting primarily of *Halodule*, in nearshore areas that are presently devoid of seagrasses.

Monitoring Protocol

The Florida Bay Fish Habitat Assessment Program (FHAP) has provided spatially explicit data on the distribution, abundance, and population dynamics of benthic macrophytes in Florida Bay since spring of 1995. This program details the magnitude and extent of distribution and abundance changes in Florida Bay's macrophyte communities through the production of distribution and abundance maps, change maps, and summary graphic and tabular products. RECOVER seagrass monitoring will continue three ongoing large-scale programs in south Florida: 1) Florida Bay FHAP, 2) the Florida Keys National Marine Sanctuary Seagrass Monitoring Program, and 3) the Dade Environmental Resource Management/South Florida Water Management District monitoring program in northeast Florida Bay.

Monitoring will be expanded to additional water bodies likely to be affected by CERP activities from Lostman's River to northern Biscayne Bay. Monitoring will be expanded to include Duck Key Basin in Florida Bay, four additional basins in the Everglades-Florida Bay ecotone, and six localities of the Gulf of Mexico coastal shelf adjacent to coastal river mouths and within Whitewater Bay. Seagrass monitoring in Biscayne Bay will be expanded to include localities south of Black Point (Sand Key to Midnight Pass), north of Black Point (Sand Key to Rickenbacker Causeway), and Rickenbacker Causeway to Port of Miami (an area that receives Miami River discharge).

Sampling grids and station locations will be generated using algorithms developed by the United States Environmental Protection Agency's Environmental Monitoring and Assessment Program (EMAP).

Sampling will be conducted once per year at the end of the dry season (May-June) when salinity stress on seagrasses may be highest, and when the dominant seagrass of the region, *Thalassia testudinum,* exhibits maximum leaf area.

At each station, seagrass cover will be visually quantified within each of four 0.25 square meter quadrants using a modified Braun-Blanquet technique. The occurrence of flowers and fruits will be noted for each quadrant. Maps of seagrass distribution, abundance, and changes in abundance will be produced. Spatial distribution of sexual reproduction will also be mapped.

Annual density and above-ground biomass measurements will be obtained from duplicate 15-cm diameter core samples at each of the Braun-Blanquet stations. At sites where *Ruppia* is present, seed densities will be determined by sieving (1.0-mm mesh) the contents of a 15-cm diameter core at each site.

At sites where seagrasses are present, ten short-shoots will be collected for the determination of leaf epiphyte biomass. Photosynthetic capacity and efficiency will be measured in situ for four short-shoots of *Thalassia* at each station where it is observed. Changes in photosynthetic characteristics in response to environmental changes should be detected before changes in standing crop, density, and cover, providing a dynamic indicator of the physiological status of the seagrasses.

Color aerial photographs and ground-truth data will be obtained and analyzed to create high-resolution digital benthic maps to characterize the spatial pattern of seagrass abundance and distribution, rather than just reporting total area of seagrass coverage. Specific objectives are to 1) assess the spatial extent and distribution of seagrass communities; 2) determine, through repetitive sampling, patterns of change in seagrass abundance and distribution as restoration efforts proceed; and 3) develop a suite of landscape-level indicators of seagrass condition. Landscape-level indicators to be evaluated will include seagrass patch-size, spatial configuration of patches (more continuous vs. patchy coverage), and various fractal measurements.

Source

Florida Bay and Biscayne Bay CEMs attribute
Southern Estuaries Monitoring and Assessment Plan module 3.2.3.3 - 3.2.3.4 (RECOVER, 2003a)

Contact

RECOVER AAT

Steve Davis, SFWMD

Assessment Performance Measure Name and Number

SE-A4 Southern Estuaries Juvenile Pink Shrimp and Associated Epifauna

Justification and Current Condition

The seagrass beds of Florida Bay, Biscayne Bay and the Gulf of Mexico coastal shelf provide essential nursery grounds for juvenile stages of the commercially valuable pink shrimp, as well as habitats for a diversity of other epifaunal fish and macroinvertebrates that are important components of estuarine ecosystems.

The drainage of the Everglades and other human activities have caused of seagrass die-offs, sustained algal blooms, and declines in lobster, fish and shrimp species within Florida Bay. It is expected that Florida Bay restoration will involve changes in freshwater flow that will not only increase the quantity of this flow, but also alter the timing and distribution of flow. A direct effect of freshwater flow restoration will be a change in the bay's salinity. The change in salinity will then affect seagrasses and shrimp. Another potential effect of the bay's restoration will be improved water quality. Decreasing the amount of nutrients coming into the bay should decrease the occurrence of algal blooms. Such blooms often occur with nutrient pollution and can negatively impact seagrass habitat and other ecosystem components.

CERP Restoration Expectation

Threshold salinity levels of 20 ppt for eastern Florida Bay and 30 ppt for western Florida Bay are the targets. Algal bloom threshold targets are 2 ppb of chlorophyll *a* in eastern Florida Bay and 3 ppb of chlorophyll *a* in central and western Florida Bay. The abundance of juvenile fish should increase. The abundance and diversity of fish and macroinvertebrates associated with seagrass beds should increase in Biscayne Bay and Florida Bay and along the Gulf of Mexico coastal shelf westward to Lostman's River. More refined targets for Florida Bay restoration are being developed as part of the Florida Bay and Florida Keys Feasibility Study.

Monitoring Protocol

One-square meter throw trap samples will be collected six times per year at three sites in Florida Bay, three in Biscayne Bay, and four in the mangrove estuaries of the southwest coast. Tentatively, Florida Bay sites will be Johnson Key basin, Whipray basin, and near Duck Key. Southwest coast sites will be Ponce de Leon Bay, Whitewater Bay, the mouth of Broad River, and the mouth of Lostman's River.

Initially, at least two habitats (distinguished by depth, distance from shore, or a combination of these variables) will be sampled at each site (i.e., two depths, two seagrass species, etc.). Three locations within each habitat will be sampled with four replications per location. The general location within which sampling of each habitat representation takes place will be fixed; however, the specific sampling point will be determined randomly. Sampling locations will be positioned to best detect changes in water management. Placement of sampling locations will be coordinated with the placement of seagrass monitoring sites, the placement of salinity recording stations, and the placement of reference sites for the Florida Bay Modeling Program. Sampling locations positions will also take into consideration the sites of the Long Term Ecosystem Research (LTER) Project in south Florida coastal waters. Salinity and water depth at the time of sampling, depth relative to surrounding areas, and characteristics of bottom vegetation and sediments will be recorded.

Source

Florida Bay, Biscayne Bay, and Mangrove Estuarine Transition Zone CEMs attribute
Southern Estuaries Monitoring and Assessment Plan module 3.2.3.5 (RECOVER, 2003a)

Contact
RECOVER AAT Steve Davis, SFWMD Joan Browder, NOAA Dave Rudnick, SFWMD

Assessment Performance Measure Name and Number

SE-A5 Southern Estuaries Shoreline Fish Community

Justification and Current Condition

One the objectives of the CERP is to attempt to restore more natural freshwater flows into Florida and Biscayne Bay and thus reclaim more of their historically estuarine structure and function. Because of their unique position at land-sea interface, it is within mainland mangrove habitats that CERP-related impacts are likely to be the strongest and most easily discerned from other effects. Previous studies in Florida Bay and Biscayne Bay indicate that these mangrove habitats support high densities of juvenile and adult stages of several economically important fishes, including snappers, grunts, great barracuda, and snook, and even higher densities of their prey (e.g., silversides, killifishes, and mojarras). If CERP can realize a return of more natural salinity regimes along the mainland shoreline, baywide increases in fish diversity and density are expected in the mangrove-fish assemblages.

CERP Restoration Expectation

Increase diversity and density of fish assemblages along the mainland mangrove shorelines of Florida Bay and Biscayne Bay.

Monitoring Protocol

This sampling protocol will continue and expand an ongoing biannual monitoring program that was initiated in 1998. The monitoring will be designed to compare fish assemblages associated with two mangrove shoreline types: mangrove shorelines along the mainland and those on the leeward side of the major keys that define the two bays' eastern-southern boundaries. Censuses will be conducted during consecutive wet and dry seasons (i.e., July to September and January to March, respectively). Exact transect locations will be chosen based on previous fish density and diversity information as well as measured and modeled salinity variation. Mainland census locations will span from Matheson Hammock (Biscayne Bay) south and west to Cape Sable (Florida Bay). Two hundred censuses per year will include two shorelines, two seasons and 50 stations. Variation in taxonomic richness and the densities of dominant taxa will be analyzed using appropriate statistical software. Statistical testing will compare shoreline differences within each season, seasonal differences within each shoreline type, and fish-habitat relationships with emphasis on salinity and salinity variation. In addition, length-frequency distribution plots will be constructed and compared for the dominant fish taxa within stable- versus variable-salinity zones.

Mangrove-fish assemblages are characterized and quantified using a modification of the visual "belt-transect" census method. This entails snorkeling 30-m long transects parallel to the shore and recording the identity, number, and size structure (minimum, mean, and maximum total length) of fishes observed. Measured landward from the prop-root edge, belt-transect width is 2 m, thus area censured per transect will be 60 square meters. All visual surveys are conducted between 0900 and 1700 hours to minimize problems of low light. Although a variety of sources can be used to identify fish to species, identification of all individuals to the species level is not possible. Therefore, identification of problematic taxa is done to the genus or family level, and small, silvery, fork-tailed fishes that tend inhabit the water-column in large schools (e.g., Engraulidae, Atherinidae, and Clupeidae) are grouped. Measurements of water temperature, depth, salinity and dissolved oxygen are obtained for each fish census. In a separate effort, a subset of the fish census sites are revisited to obtain microhabitat measurements such as density and diameter of prop-roots as well as an index of the coverage of attached organism assemblages on the roots (i.e., measured as the maximum diameter of the attached organism assemblage).

Source
Florida Bay, Biscayne Bay, and Mangrove Estuaries CEMs attribute Southern Estuaries Monitoring and Assessment Plan module 3.2.3.6 (RECOVER, 2003a)
Contact
RECOVER AAT Steve Davis, SFWMD

Assessment Performance Measure Name and Number

SE-A6 Florida Bay Juvenile Spotted Seatrout

Justification and Current Condition

The spotted seatrout is an important game fish that spends its entire life in Florida Bay. Previous research in Florida Bay has demonstrated that spotted seatrout distributions vary in response to salinity conditions in the western and central portions of the bay. Prior to the seagrass die-off and hypersaline conditions that occurred in the 1980s, seatrout distributions were mainly limited to the western portion of the bay and were absent from the central region. During 1994-2001, when hypersaline conditions in the north-central area of the bay were rare or absent, the distribution of spotted seatrout juveniles expanded into the central portion of the bay.

The spotted seatrout is considered a key species relative to the implementation of the CERP. The restoration of water levels that allow sheet flow over the Buttonwood Embankment from Madeira Bay westward should alleviate detrimental hypersaline conditions and thereby increase the distribution, growth and survival of juvenile spotted seatrout in Florida Bay.

CERP Restoration Expectation

Increase distribution, abundance, growth and survival of juvenile spotted seatrout in north-central and western Florida Bay.

Monitoring Protocol

This monitoring protocol is a continuation and expansion of an ongoing spotted seatrout monitoring program conducted by Everglades National Park. Juvenile spotted seatrout will be sampled bimonthly at 18 stations in the central and western portion of Florida Bay (from Madeira Bay to Sandy Key), including the north central Bay where hypersaline conditions often occur. Sampling will be conducted with a small otter trawl. The monitoring will evaluate if there is a consistent pattern of spotted seatrout distribution and abundance in the north central area during restoration, thereby providing the basis to predict distribution as a function of salinity. Salinity, turbidity and temperature will be measured between the 18 stations. Seagrass standing crop and composition, salinity, sediment and water depth, turbidity, and temperature at will be measured at each station. Subsamples of seatrout collections will be evaluated for age, growth, and mortality using otolith microstructure analysis. Based on a detailed analysis of previous data, the existing draft performance measure for spotted seatrout will be refined.

Source

Florida Bay CEM attribute
Southern Estuaries Monitoring and Assessment Plan module 3.2.3.7 (RECOVER, 2003a)

Contact

RECOVER AAT

Steve Davis, SFWMD

Assessment Performance Measure Name and Number

SE-A9 Southern Estuaries Nutrient (TP and TN) Concentrations in Surface Water

Justification and Current Condition

Alterations in quality and quantity of water released into the southern estuaries, as a result of the modifications inherent in the original C&SF Project, has resulted in a dramatic increase in the concentration of nutrients. This increase in nutrient (TP and TN) concentration has resulted in increased frequency and severity of algal blooms, loss of extent and density of seagrass beds, the rate of detrital accumulation of reducing estuarine sediments. These have, in turn, resulted in hypoxia, failure to meet Class III-marine dissolved oxygen standards, and degradation of benthic faunal communities.

Chapter 62-602, F.A.C., and Chapter 24 of the Code of Metropolitan Miami-Dade County established water quality standards for the surface waters of Biscayne Bay. Chapter 62-602 also establishes an "Antidegradation Policy" for surface waters and limits the introduction of excessive nutrients into waters of the state. In addition, Chapter 62-602 identifies Biscayne Bay as an Outstanding Florida Water and establishes an antidegration rule for bay waters. For Florida Bay, the Everglades Forever Act (Section 373.4592, F.S.) and Federal Everglades Settlement Agreement (U.S. District Court case no. 88-1886-CIV-HOEVELER) mandates no additional input of phosphorus into the bay. However, algal blooms can also be caused by nitrogen additions. CERP projects which propose to modify drainage and/or canal discharge patterns, or affect sources of freshwater discharge may affect nutrient concentrations in these southern estuaries.

Open areas of Biscayne Bay generally exhibit low nutrient concentrations (historic range from 0.001 to 0.015 mg/L of TP and from 0.043 to 1.066 ppm of TN). However, areas surrounding major canals that discharge in to the bay can have higher nutrient concentrations (historic range between 0.010 and 0.030 mg/L of TP and between 0.101 and 1.344 ppm TN). Some canals that drain older, more urbanized or agricultural areas of the watershed typically exhibit higher nutrient concentrations than those observed in other areas of the region (historic range between 0.001 and 0.130 mg/L of TP and between 0.17 and 2.21 ppm of TN).

CERP Restoration Expectation

Florida Bay – Current nutrient concentrations of surface water inputs from the Everglades and from Florida Keys should not be exceeded so the oligotrophic conditions of the bay are maintained.

Biscayne Bay – Maintain or reduce surface water nutrient concentrations so not to exceed historical background, and not to exceed a monthly average concentrations of 0.005 mg/l for TP and 0.80 mg/l for TN in open portions of the estuaries.

Monitoring Protocol

TP and TN should be measured monthly in surface waters throughout the estuaries and at all major canals and creeks discharging into the estuaries utilizing existing monitoring networks and following protocols outlined in the draft CERP QASR Manual (RECOVER, 2003c).

Nutrient monitoring in Florida Bay should include monthly grab sample measurements at fixed stations within the bay and adjacent marine waters, and sampling at inflows to Florida Bay using auto samplers and monthly grab samples.

Source
Florida Bay and Biscayne Bay CEMs stressor Southern Estuaries Monitoring and Assessment Plan module 3.2.3.1 (RECOVER, 2003a) RECOVER, 2000c
Contact
RECOVER WQT Susan Markley, Miami-Dade DERM Steven Blair, Miami-Dade DERM David Rudnick, SFWMD

Assessment Performance Measure Name and Number

SE-A10 Southern Estuaries Nutrient (TP and TN) Loads

Justification and Current Condition

Alterations in quality and quantity of water released to the southern estuaries, as a result of the modifications inherent in the original C&SF Project has resulted in a dramatic increase in the load of nutrients. This increase in nutrient (TP and TN) loads has resulted in an increase in the frequency and severity of algal blooms, loss of extent and density of seagrass beds, and increase in rate of detrital accumulation of reducing estuarine sediments. These conditions have, in turn, resulted in hypoxia, failure to meet Class III marine dissolved oxygen standards, and degradation of benthic faunal communities.

Chapter 62-602, F.A.C. and Chapter 24 of the Code of Metropolitan Miami-Dade County established water quality standards for the surface waters of Biscayne Bay. Chapter 62-602 also establishes an "Antidegradation Policy" for surface waters and limits the introduction of excessive nutrients into waters of the state. In addition, Chapter 62-602 identifies Biscayne Bay as an Outstanding Florida Water and establishes an antidegration rule for bay waters. For Florida Bay, the Everglades Forever Act (Section 373.4592, F.S.) and Federal Everglades Settlement Agreement (U.S. District Court case no. 88-1886-CIV-HOEVELER) mandates no additional input of phosphorus into the bay. However, algal blooms can also be caused by nitrogen additions. CERP projects which propose to restore hydrologic conditions by modifying drainage and/or canal discharge patterns, or altering sources of freshwater discharge may affect nutrient loading to these southern estuaries.

CERP Restoration Expectation

Limit nutrient (TP and TN) loads such that the bays maintains the conditions needed to support normal algal, seagrass, and benthic communities. Nutrient loads should be reduced to achieve the estuaries' respective TMDL targets (if the water bodies are classified as "verified impaired" per Florida's Impaired Waters Rule), restoration targets of degraded waters as developed by the Comprehensive Integrated Water Quality Feasibility Study, and/or Florida's numerical nutrient standards for estuarine waters as they are promulgated.

Current targets for Southern Estuaries are as follows:

Florida Bay – Maintain or reduce current nutrient loads from Everglades inflows and the Florida Keys.

Biscayne Bay – Maintain or reduce nutrient loads so not to exceed historical background. Achieve a 47 percent reduction in TN loading.

Monitoring Protocol

Conduct monthly grab and auto sampler assays for surface water nutrient concentrations at major inflows to the estuaries, along with measured flow volumes. Utilize South Florida Water Management District established protocol to calculate loads. Measurements should be continuous or semicontinuous for flow, conductivity and TP and TN.

Source
Florida Bay and Biscayne Bay CEMs stressor Southern Estuaries Monitoring and Assessment Plan module 3.2.3.1 (RECOVER, 2003a) Cloern, 2001
Contact
RECOVER WQT – AAT Greg Graves, FDEP Susan Markley, Miami-Dade DERM David Rudnick, SFWMD

Assessment Performance Measure Name and Number

SE-A11 Algal Bloom Frequency, Intensity and Duration

Justification and Current Condition

The C&SF Project caused hydrological and land use alterations that increased nutrient (TP and TN) availability. This increased nutrient availability may have resulted in increased frequency, severity, duration and spatial extent of algal blooms. Algal blooms are also related to change of water flow, which affects bloom dynamics (species abundance, distribution and bloom movement). These elements must be evaluated in addition to looking at chlorophyll *a* concentrations.

During the summer and fall algal blooms occur in the central and western regions of Florida Bay. Cyanophytes dominate the blooms occurring in the central bay and diatoms dominate those occurring in the western bay and Gulf transition region. Typical bloom peaks are 5 to 10 ppb.

Conditions in northern Biscayne Bay, while showing higher nutrient conditions and chlorophyll *a* concentrations, have not supported persistent algal blooms as seen in Florida Bay. Southern and central Biscayne Bays maintain oligotrophic conditions (nutrient and chlorophyll) that have not supported prolonged algal blooms.

CERP Restoration Expectation

For Florida Bay, decrease or cause no net increase in the frequency, duration, intensity or spatial extent of algal blooms relative to conditions documented since 1991.

For northern Biscayne Bay, have no net increase in algal blooms. For the open waters of central and southern Biscayne Bay, the frequency of algal blooms should be zero. Chlorophyll *a* concentrations should be within historic levels: annual means of 1 to 4 μg/L for the northern Bay, and less than 0.5 μg/l or the open waters of central and southern Biscayne Bay.

Monitoring Protocol

Measurements should be conducted by periodic grab samples from fixed stations of phytoplankton biomass, as indicated by chlorophyll *a* and in vivo fluorescence made at proper spatial and temporal scales that are coincident with other water quality and seagrass measurements. Monitoring should follow the protocols outlined in the draft CERP QASR Manual (RECOVER, 2003c).

Automated and semicontinuous measurement of fluorescence at fixed sites should be considered, as well as remote sensing of phytoplankton pigments. These have the potential to considerably improve the temporal and spatial resolution of bloom monitoring. Measurements should include some class-specific taxonomic identification of the phytoplankton assemblage, phytoplankton species abundance/distribution and various ratios of different phytoplankton species.

Source

Florida Bay and Biscayne Bay CEMs attribute

Southern Estuaries Monitoring and Assessment Plan module 3.2.3.1 (RECOVER, 2003a)

Dennison et al., 1993
RECOVER, 2002c

Contact
RECOVER WQT – AAT Greg Graves, FDEP David Rudnick, SFWMD Susan Markley, Miami-Dade DERM

Assessment Performance Measure Name and Number

SE-A12 Southern Estuaries Water Clarity/Light Penetration (PAR)

Justification and Current Condition

Biscayne Bay and Florida Bay support large areas of seagrass. These areas function as vital habitat to support critical life stages for a variety of ecologically, economically and recreationally important species. Healthy seagrass communities require clear water with good light penetration, and oligotrophic nutrient conditions. In return, they provide food and shelter and stabilize bay bottom sediments that help to maintain and improve water clarity. Field measurements of water clarity are needed to establish linkage between seagrass development and hydrologic and water quality restoration within the estuaries. Pulse releases of water from canal systems can result in episodic increases in water color, suspended solids, and other materials and processes which, taken together, can decrease the depth to which photosynthetically active radiation (PAR) is sufficient to support submerged seagrass communities. Such communities are critical key habitat and foodstuff required to support balanced and healthy estuarine communities of fish and shellfish. Modifications to water management strategies associated with the CERP have potential to alter turbidity, color or nutrient loading patterns that, in turn, affect water clarity. Turbidity resulting from nutrient loading (growth of phytoplankton or algal blooms) must be distinguished from that caused by resuspension of sediments or dissolved organic matter. Increasing phytoplankton (algal blooms) absorbs light more efficiently than other particles and contributes to degraded water quality.

Current conditions show large regions of Biscayne Bay having clear water supporting healthy seagrass communities, with mean turbidity ranges between 0.5 to 2.0 NTU and light attenuation coefficients ranging from 0.36 to 0.54. However, some areas of northern Biscayne Bay exhibit reduced water transparency that limits the depth at which seagrass can grow, with mean turbidity ranges between 1.0 and 4.3 NTU and light attenuation coefficients ranging from 0.36 to 0.95.

In Florida Bay, current conditions are characterized by the occurrence of turbid water in many parts of the bay. In the eastern bay, much of this turbidity is caused by algal blooms and resuspended sediments. Because turbidity caused by resuspended sediments is likely a natural condition in much of the bay, clear water is not a restoration target. Light penetration, however, should be sufficient to support net production by seagrasses.

CERP Restoration Expectation

Maintain existing water transparency (clarity) in clear regions of Biscayne Bay presently supporting healthy seagrass communities, and improve water clarity in those regions of estuaries where reduced water clarity is limiting growth of seagrasses.

In Florida Bay, light penetration should be sufficient to support net production by seagrasses.

The link between seagrass and hydrological restoration cannot be made without light field monitoring. Light attenuation coefficient (Kd) should not exceed established background conditions, nor should the absolute value for a daily average exceed 0.7 in any area.

Monitoring Protocol

Monitoring should include no less than monthly measurements of PAR light values with calculation of attenuation coefficients at strategic locations within the estuaries. Additional monitoring in the form of increased sampling frequency and/or additional sampling stations should be associated with CERP projects that may likely affect water transparency. Monitoring should follow the protocols outlined in the draft CERP QASR Manual (RECOVER, 2003c)

In Florida Bay, monitoring must include measurements of light (PAR) attenuation, suspended solids, phytoplankton (with chlorophyll *a* as a surrogate), and dissolved organic matter (with direct measurement of dissolved organic carbon and color). These measurements need to be made at proper spatial and temporal scales that are coincident with other water quality and seagrass measurements. Some continuous light field (PAR), DOM (DEFINE) fluorescence, and particle turbidity (transmissivity) monitoring stations should be deployed and maintained.

Source

Biscayne Bay and Florida Bay CEMs
Southern Estuaries Monitoring and Assessment Plan module 3.2.3.1 (RECOVER, 2003a)

Cloern, 2001
RECOVER, 2002c
SFWMD, 1995b

Contact

RECOVER WQT – AAT

Greg Graves, FDEP
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Assessment Performance Measure Name and Number

SE-A13 Contaminants (Toxicants and Pathogens) in Biscayne Bay Tributaries and Coastal Sediments

Justification and Current Condition

Sediment quality and toxicant/pathogen input is a stressor of the Biscayne Bay Conceptual Ecological Model. It is linked to dissolved and suspended solids inputs and sediment contamination. These stressors are particularly significant in urban estuaries, where contaminants such as pathogens, heavy metals and synthetic organic chemicals may enter the system through stormwater runoff, sewage or industrial discharges, and agricultural practices. Because of low solubility in water and dilution, many of these contaminants may be difficult to detect in water, but tend to associate with sediments and may accumulate to levels known to cause biological effects.

Current conditions show that toxicants, such as heavy metals, PCBs, pesticides and PAHs have accumulated in urban area sediments of Biscayne Bay and its tributaries to levels known to cause toxicity and other biological effects (MacDonald, 1994; Long et al., 1999; Hefty et al., 2001; Corcoran et al., 1983; Alleman, 1995; Schmale, 1991; Miami-Dade DERM, 1993; Gulf Engineers and Consultants, 1993; Seal et al., 1994). Water column toxicants and pathogens such as ammonia and sewage related pathogens are also present (Alleman, 1995; Miami-Dade DERM, 1993; Hefty et al., 2001).

CERP projects were not formulated to address toxicants and pathogens (SFWMD and USACE, 2003), but these pollutants are considered constraints on the restoration effort. CERP projects that result in redistribution of water may affect fate and transport of existing contaminants (both in the water column and the sediments) already present in the Biscayne Bay system. CERP projects proposing to meet water quantity goals with alternative water sources, such as wastewater reuse, may introduce or alter potential for release of contaminants to previously uncontaminated sensitive areas. Also, changes in water management practices may affect conveyance of contaminated sediments or change exposure pathways. Therefore, these contaminants must be measured and assessed and corrective action taken if the geographic extent or degree of sediment toxicity increases as a result of CERP implementation.

CERP Restoration Expectation

The geographic extent and concentration of sediment toxicity and water column toxicants/pathogens in Biscayne Bay and the coastal wetlands should not increase.

Monitoring Protocol

Monthly monitoring of ammonia and sewage related bacteriological indicators in areas where modified water deliveries may effect the spatial distribution and concentration of these contaminants, as well as selected ‘reference’ locations. Following protocols outlined in draft CERP QASR Manual (RECOVER, 2003c), conduct biannual long-term sediment chemistry and toxicity testing to document spatial and temporal patterns in contaminant levels throughout the watershed, with emphasis on canals and adjoining coastal waters. Baseline information has been collected by National Oceanic and Atmospheric Administration, Florida Department of Environmental Protection and Miami-Dade County Department of Environmental Protection. The sampling protocols established through these monitoring programs should be continued. Parameters should include trace metals (arsenic, cadmium, chromium, copper, lead, mercury, and silver), PAHs, PCBs, and pesticides. Bioassays should include standard whole sediment and pore water toxicity protocols. For any CERP project including wetland stormwater treatment/redistribution or wastewater reuse, site-specific baseline sediment chemistry and toxicity monitoring should be conducted, with follow-up annual monitoring.

Source
Biscayne Bay CEM stressor Southern Estuaries Monitoring and Assessment Plan module 3.2.3.1 (RECOVER, 2003a) Alleman, 1990, 1995 Long et al., 2000 Markley et al., 1990 McDonald, 1994 Miami-Dade DERM, 1993 RECOVER, 2002c Seal et al., 1994 SFWMD and USACE, 2003
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